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(54) Title: IMPROVEMENT OF THE REDUCTION PROCESS IN P CONTENT AND OTHER GANGUES IN IRON ORE AND ITS AGGLOMERATES (57) Abstract Invention patent for improvement in reduction process of contents of P and other gangues in iron ore and its agglomerates, in which a phase of thermic pretreatment of the ore is used, making an agglomeration (briquetting, pelletizing and sintering) thereof, before submitting it to the leaching phase with hydrochloric acid, hydrochloric gas, chlorides and their by-products, as leaching agents.		

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"IMPROVEMENT OF THE REDUCTION PROCESS IN P CONTENT
AND OTHER GANGUES IN IRON ORE AND ITS AGGLOMERATES"

This invention lies in the field of Mineral Processing and refers to an improvement in the process of reduction of P contents and other
05 gangues in iron ore and its agglomerates.

Phosphorus (P), alumina (Al_2O_3) and silica (SiO_2) are the most common impurities to be found in iron ore.

Generally, silica contents are slightly reduced by the application of conventional mineral concentration techniques, such as gravimetric,
10 magnetic, flotation separation and others. Currently, the only process being used for reducing P and Al_2O_3 in iron ore is the elimination of fines (finer granulometric fractions with higher percentages of these impurities). The elimination of these fines can be accomplished by dry or wet process and, in the latter case, the operation is given the
15 name of sliming. Equipment used therefor are screens, fluid classifiers, such as cyclones, fluid separators, mechanical classifiers and others.

Maximum limits of P and Al_2O_3 contents in iron ore and its agglomerates as specified by the consumer market vary on the basis of the pur
20 poses for which the raw material is intended. For less noble purpose products are accepted with up to 0,08% P and 1,5% Al_2O_3 . More severe specifications, of products for nobler purposes, restrict to 0,02% the content of P and 1,0% the content of Al_2O_3 . Often the utiliza
tion of the fines elimination technique is not sufficient to attain
25 the levels of these impurities as required by the consumer market.

This invention is an improvement of the "Process for the reduction of P and Al_2O_3 contents in iron ores", based upon the process provided for under patent application number 8802450, filed on August 17th, 1988 which makes use of hydrofluoric acid as a leaching agent.

30 This application bears an improvement of the reduction process of P contents and other gangues in iron ores and its agglomerates, in which a phase of thermic pretreatment of ore is used, making an agglomera-

tion (briquetting, pelletizing, sintering) thereof, before making it undergo the leaching process with hydrochloric acid, hydrochloric gas, chlorides or their by-products.

Thermic treatment at 1.200 °C causes a structural rearrangement of hematite and goethite (the latter becoming hematite) so that its dissolution with mineral acids becomes difficult. At the same time, there is a migration of associated gangues to the surface of the particles, thus facilitating the attack and its dissolution with mineral acids.

10 Examples of leaching yields in pelletized and sintered ores with the use of HF and HCl.

TABLE 1

P e l l e t

	Before leaching	After leaching w/HCl	% Reduction	After leaching w/HF	% Reduction
15 Fe	67,83	67,88	-0,07	68,08	-0,37
SiO ₂	1,28	1,02	20,3	0,83	35,2
Al ₂ O ₃	0,51	0,46	9,8	0,48	5,9
20 P	0,029	0,019	34,5	0,020	31,0
CaO	0,56	0,35	37,5	0,53	5,4
MgO	0,22	0,19	13,6	0,20	9,1

The burnt pellet underwent the new process for reducing the contents of P and gangues. The static leaching technique was used. The sample to be leached, weighing 1.000 g, was placed into an adequate recipient. Then 250 ml of HF at 5,5 M solution were added.

After 60 minutes of contact of the solution and the solid particles, with no stirring whatsoever and at room temperature (28°C), the slurry was filtered (with the aid of a paper filter), rinsing thereafter the solid with running water, drying at 90°C. The use of HCl as a leaching substance is predictable since chlorine is the subsequent element in the halogen class. However, without the prior preparation of ore HCl was not effective at all. Thus, the improvement process we

are discussing is based upon the association of thermic treatment and the use of HCl as a leaching agent.

Tests were carried out, replacing HF 5.5 M (10%) for HCl 2.5 M (10%), arriving at the above result (table 1). HCl does not perform so well in ores which have not been subject to prior thermic treatment. We have also observed that in combination with pelletizing and sintering (agglomerations with thermic treatment), HCl is rather efficient.

In aqueous solutions, the mass proportion of the reagents indicated hereinabove for water mass can vary from 0% to 100%. The leaching process may occur at room temperature or then heating the slurry at temperatures lower than 100%.

In gaseous solutions the mass proportion of the reagents indicated for water vapor mass or water vapor/air mixture may vary from 0% to 100%, and the leaching process may occur at room temperature or with heating up to 100 °C temperature for aqueous solutions and temperature above 100°C for gaseous solutions.

The process may involve the recirculation of the leaching solution or not, regeneration of the reagents or not. There may also be used leaching by percolation in situ, in stacks, in columns or in the other devices for percolation, suspension leaching with agitation or static or any other leaching techniques. The material to be leached is the one thermically treated after agglomeration (briquetting, pelletizing or sintering). After the leaching process the ore may be used with water or not and the slurry may undergo thickening and/or filtering and/or drying or not.

The ore thus processed has its contents of P, Al₂O₃, CaO and MgO reduced to values within specifications. The examples indicated hereinafter clearly confirm the efficiency of the improvement described for this process, with the materials used, such as sinter, pellets, etc , coming from industrial plants.

EXAMPLE 1

The burnt pellet was submitted to the new process for reducing the contents of P and Al_2O_3 . The static leaching technique was used.

The sample to be leached, weighing 1.000 g, was placed inside an adequate recipient. Then 250 ml of HCl at 2,5M solution were added. After sixty (60) minutes of contact of the solution and the solid particles, without any agitation and at room temperature, the slurry was filtered (with a paper filter), then washing the solid in running water and drying it at 90°C . The table hereunder compares the contents of Fe, SiO_2 , Al_2O_3 , P, CaO and MgO in the sample prior to and after leaching.

PELLET SAMPLE

		Before leaching	After leaching	% Reduction
15	MASS (g)	1.000 g	995 g	0,5
	Fe	67,83	67,88	- 0,07
	SiO_2	1,28	1,02	20,3
	Al_2O_3	0,51	0,46	9,8
	P	0,029	0,019	34,5
20	CaO	0,56	0,35	37,5
	MgO	0,22	0,19	13,6

EXAMPLE 2

The sinter was submitted to the new process for reducing the contents of P and Al_2P_3 . The static leaching technique was used.

The sample to be leached, weighing 1.000 g, was placed inside an adequate recipient. Then 250 ml of HCl at 2,5M solution and the solid particles, without any agitation, at room temperature, the slurry was filtered (in paper filter), then washing the solid with running water and drying it at 90°C . The following table compares the contents of Fe, SiO_2 , Al_2O_3 , P, CaO and MgO in the sample prior to and after leaching.

SINTER SAMPLE

		Before leaching	After leaching	% Reduction
	MASS (g)	1.000 g	978 g	2,2
05	Fe	57,63	59,34	- 2,4
	Al ₂ O ₃	1,75	1,45	17,1
	P	0,060	0,046	23,3
	CaO	8,02	7,26	9,5
	MgO	1,55	1,51	2,6

10 Even though leaching with HCl at tested concentrations and temperatures have been the preferred mode of working in this invention, it should be understood that several alterations may be carried out without leaving the realm of the invention. Some of its elements may be replaced by others which shall play the same technical role, particularly the concentrations of solutions used, the percentage of solids in the slurry and the utilization of other acids, gases and/or their by-products either individually or combined among one another.

C L A I M S

1. "IMPROVEMENT OF REDUCTION PROCESS OF CONTENTS OF P AND OTHER GANGUES IN IRON ORE AND ITS AGGLOMERATES", characterized for presenting a phase of thermic pretreatment of ore, making an agglomeration
05 (briquetting, pelletizing or sintering) thereof, before submitting it to the leaching phase, with hydrochloric acid and/or gas and their by-products, whose concentrations vary from 0 to 100% in water mass, at room temperature or with pulp heating at temperature lower than 100° C.
- 10 2. "IMPROVEMENT IN REDUCTION PROCESS OF PHOSPHORUS AND ALUMINA AND IRON ORES AND THEIR AGGLOMERATES", as provided for under claim 1, characterized because the ore is leached, washed with water or not, submitted to thickening and/or drying operations or not.